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Designing Organizations: Does Expertise Matter?

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Abstract From an organizational cognition standpoint, we approach organizational design as an ongoing creative sensemaking process. This study examined the role of expertise in the cognitive problem-solving patterns underlying design processes and the resulting organizational forms. The simulated problem elicited the mental models applied by naives, novices, and experts in designing an organization. The thinking-aloud protocol analysis revealed quantitative and qualitative expert/nonexpert differences in problem-solving strategies, the time spent on problem representation, and the justifications and difficulties expressed in the course of the design process. In addition, our results showed that naives created organizations consistent with mechanistic structures, while novices and experts created organizations consistent with organic structures. We discuss the implications of these findings for the understanding of the cognitive basis of organizational design and the development of effective training programs.

Keywords Expert-novice study · Mental models · Organizational cognition · Organizational design · Protocol analysis

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Introduction

The profound social, technological, and cultural changes taking place in contemporary societies require new forms of organization (European Commission 2000). These changes and the intense pressure to maintain optimum levels of effectiveness compel companies to review their processes and structures ever more frequently and explicitly, resulting in a renewal of interest in the subject of organizational design. Traditional notions of design and organization have been supplanted by concepts such as organizing, designing and improvising, which emphasize the dynamic and creative nature of the organizational design phenomenon (e.g., Rousseau 1997; Weick et al. 2005; Wrzesniewski and Dutton 2001). In this context, the organizational cognition approach is particularly important because it recognizes the subtle, active, transformational role of the organization's members in the design activities.

Organizational design is a key area of decision-making for companies. Taking an organizational cognition approach, we frame organizational design as a sensemaking process (Forbes 1999; Weick et al. 2005) by which people shape and search for a particular structure capable of ordering the intrinsic flux of human action and channeling it towards certain ends (Tsoukas and Chia 2002). In this study, we seek to extend our understanding of the determinants in this process by focusing on the mental models people construct and use to deal with the uncertain organizational design problems. Cognitive psychology has shown that individuals' expertise notably impacts such mental models (Ericsson and Smith 1991; Glaser 2000). We argue that expertise relates to organizational design by providing individuals with mental models regarding which organizational forms are more effective, and this in turn guides subsequent decisions and actions. Thus, our study

integrates contributions from the fields of organizational behavior and expertise research to examine what is going on in the minds of people with differing levels of domain-relevant expertise when creating an organizational form. Understanding the factors that facilitate design processes can help us to develop interventions aimed at enhancing this process and, by extension, organizational performance.

In the next section, we discuss the main conceptual and empirical work in the area of organizational design from a cognitive stance taking into account the role of expertise.

Theoretical Background

Traditionally, organizational design has been defined as the process by which the structure of an organization is created or changed in order to achieve certain rationally pursued objectives (e.g., Bolman and Deal 1991; Mintzberg 1991; Robbins 1990). Though conceptualized as a process, organizational design is still treated as a discrete event involving a small group of people, normally managers and technical experts, whose task is to choose ideal structures capable of coping with continuous changes in the internal and external environments of the organization (Harrison and Shirom 1998; Hutchins 1991; Weick 1993). This thinking lies at the heart of structuralist and contingent approaches to design, which hold that the form of an organization is directly dependent on factors such as the environment, strategy, technology and size. The proposal of Baligh et al. (1996) may be taken as the maximum expression of this approach. According to these scholars, organizational design is a normative science based on organization theory, which prescribes how certain elements can be combined to create effective organizations capable of maintaining an optimal fit between contingent factors, properties and structures.

Although structuralist-contingent approaches have made valuable contributions in clarifying the relationships between environment, structure and organizational outputs, they are based on a stimulus-response outlook (e.g., uncertain environment-decentralized structure) which is unable to explain what mechanisms bind these components together (Daft 2006; Daft and Weick 1984; Ford and Hegarty 1984; Rico and Fernández-Ríos 2002). In response to this mechanistic treatment of organizational design, scholars working in the field of organizational cognition have argued in favor of investigating the phenomenon from the standpoint of the people who actually resolve the design dilemmas. This cognitive perspective on design assumes that the forms adopted by an organization over time are the result of the way in which people make sense of the context and organizational events (Forbes 1999; Weick 1993), and how they utilize meanings to create or change the rules, procedures, technologies and other elements that define an organization in operational terms (Harrison and Shirom 1998; Lewin and Stephens 1993). Thus, the interest of this approach lies not in the organizational factors themselves but in the way people experience, construe and translate them into specific design options.

Despite the increasing emphasis on the cognitive factors involved in organizational design, little empirical work to date has directly examined the role of cognitive representations in organizational design. In her case study, Bartunek (1984) described how changes in the interpretative schemas related with the organization's mission were associated with changes in the organizational structure (i.e., shift from a mechanistic to an organic structure). She attributed the schema–structure relationship to the mediation of actions and affective reactions among organizational members towards the organization itself, arguing that this relationship was reciprocal. Subsequent research has partially supported this approach. Bartunek and Franzak (1988) found that individuals' frames of reference regarding factors associated with their importance in the organization changed in line with qualitative changes in the organizational structure. Similarly, Rico et al. (2004) have reported that the perceived effectiveness of an organization rose after it had been redesigned in conformity with the implicit theories held by its members regarding the most appropriate structures to suit different areas of organizational effectiveness.

Research to date has focused on the analysis of stable cognitive representations, such as concepts, schemas and implicit theories, using questionnaires and cognitive mapping techniques (Bartunek and Franzak 1988; Ford and Hegarty 1984; Rico et al. 2004). While this underscores the symbolic nature of organizational design, any attempt to examine the cognitive foundations of the phenomenon more closely involves investigating the sensemaking process in specific situations or, as Walsh (1995) pointed out, the relationships between cognition and action in a dynamic sense. In this respect, cognitive researchers have proposed the mental model construct to refer to the dynamic mental representations that individuals build up ad hoc in their working memory in response to specific, new situational demands (e.g., Gentner and Stevens 1983; Johnson-Laird 1994; Markman and Gentner 2001).

We argue that the mental models perspective is appropriate to the cognitive analysis of organizational design for several reasons. First, the absence of ideal or standard solutions in the context of organizational design means decisions must be taken under uncertain circumstances (Hutchins 1991; Galbraith 1995), requiring the active creation of mental models to fit the specific features of each organization. Also, the use of mental models makes room

for Weick's (1993) argument that design occurs to the extent that individuals notice, interpret, implement, disseminate and legitimize sequences of action that represent improvements for the organization. Finally, the form and content of mental models vary depending on expertise in specific domains of knowledge. In general, experts construct more specific, complete and elaborate task-related mental models in their area than novices (e.g., Glaser 2000; Oura and Hatano 2001; Patel and Groen 1991; Royer et al. 1993), which indicates that mental models can be transformed through appropriate learning experiences.

Despite the importance of prior training and experience for the nature of mental models, the role of expertise in sensemaking processes in organizational settings has rarely been examined. One exception is the work of Day and Lord (1992), who analyzed expert-novice differences in the categorization of problems related to a manufacturing industry. Our study contributes to filling this research gap by examining how expertise impacts both the design process and its resulting organizational forms. In particular, we focus on the cognitive problem-solving patterns experts and nonexperts use to resolve a relevant simulated organizational design problem. We analyzed the study's results under the general hypothesis that differences in the actions of experts and non experts reflect differences in the structure and content of their mental models. Next, we discuss some key findings of expert-novice research in order to identify the implications of expertise for organizational design.

Expert/Nonexpert Cognitive Processing and Organizational Problem Solving

Cognitive science has provided a wealth of evidence that people represent and solve problems in a given domain in tune with their own expertise. However, this evidence has largely been obtained in studies that look at expertise in the context of well-defined and structured problems (e.g., Alexander 1992; Ericsson and Smith 1991; Rouse and Morris 1986). Though more sparse, research into expertise in solving complex, ill-defined problems reveals a series of expert/nonexpert differences that enrich our view of the subtle (yet essential) role of cognition in organizational design. As far as we know, this is the first study that builds from expertise research findings to systematically analyze how expertise in the domain shapes organizational design.

One area of interest refers to problem-solving methods and procedures. Poorly defined problems lack clear rules and criteria to evaluate the appropriateness of solutions, tending rather to raise open-ended questions for which there are no unanimous answers (Zeitz 1994). The basic rules that guide the organization of work have rarely been made explicit or generally accepted. Under these circumstances, people turn to general strategies such as case-based reasoning, imagination and means-ends analysis to solve problems, regardless of their level of expertise (Adelson and Soloway 1988; Peskin 1998; Voss and Post 1988). It has been noted that expert/nonexpert differences are rooted in the knowledge base on which such strategies act. Using a problem about the economy of the former Soviet Union, Voss et al. (1983) observed that both experts and novices applied a strategy of identifying and eliminating causes. However, while the experts based their strategy on abstract mental models containing knowledge of the implicit causes of the problem, the novices built much more concrete models. Accordingly, we hypothesize that: *both experts and nonexperts will employ general problem-solving strategies to deal with an organizational design problem* (H1).

The phase of problem representation is a further source of differences. It has been observed that experts spend longer than nonexperts on the qualitative analysis of the problem in the early phases (Ericsson and Smith 1991). Research has shown how the representation of a problem significantly determines the solution adopted, guiding the search for possible solutions through the problem space (Glaser and Chi 1988). For example, in the problem of the Soviet economy mentioned above, 24% of the experts' verbal protocols (vs. 1% of the novices' protocols) were connected with the representation of the problem. Through their initial elaboration of the problem, the experts were able to create a mental model which they used as a basis to infer the defining relationships in the situation and add constraints (e.g., the prevailing ideology of the country). Thus, having developed an operative mental model, the solution followed directly (Voss et al. 1983). The utility of this representation phase for organizational design problems is evident, since they involve multiple open constraints (Simon 1973). Thus, the values of key variables (e.g., environment, technology, workers' competences) must be defined and agreed by organizational members. Therefore, we expect that: *experts will spend more time representing an organizational design problem than nonexperts* (H2).

A final feature concerns experts' ability to reason about problems in their field. Prior studies have found that experts in relatively unstructured domains (e.g., social sciences, jurisprudence, or literature) address their efforts to justifying and examining extensively their proposed solutions, developing relevant arguments that include their specialized knowledge (Lawrence 1988; Peskin 1998; Zeitz 1994). This tendency has been attributed to the absence of generally accepted solutions in the domain (Voss and Post 1988). Considering that organizational design offers hardly any such solutions, the ability to argue a given approach may add substantial value for the

sponsors of a particular design. The construction of sound arguments and their dissemination throughout an organization facilitates the acceptance, legitimization and implementation of a given design option by its members. Thus, experts may enjoy an advantage because their knowledge allows them to identify key principles and relationships. By contrast, nonexperts are obliged to rely on intuitive beliefs about organizations, and their arguments are therefore likely to be weak. Hence, we hypothesize that: *when dealing with an organizational design problem, experts will justify their proposals more frequently than nonexperts* (H3). In addition, *the justifications built by experts to support their proposals will be more relevant than those built by nonexperts* (H4).

Expert/Nonexpert Organizational Forms

The second purpose of our study is to ascertain what organizational forms people develop in unconstrained organizational design problems where they are able to decide which criteria to apply and how to combine them. We consider two questions in this respect. Do organizational forms vary depending on expertise in the domain? And, are these forms similar to the organizations proposed in the literature? Given that past research has not directly addressed these issues, we have adopted an exploratory approach in this study.

On the question of what types of organization will be developed by people with differing expertise, some studies suggest potential relationships between expertise, mental models and organizational structures. Comparing the cognitive maps of MBAs and executives, Ford and Hegarty (1984) found a high level of intergroup agreement regarding the relationships between the context variables, structure and performance of organizations. Furthermore, these cognitive maps exhibited a causal structure similar to that of contingent organization theories. Joyce et al. (1997) found that the perceptions of different groups of executives (e.g., top management team, functional managers) concerning the costs, benefits and factors facilitating lateral structures were consistent with general conclusions of organizational research. Given the characteristics of the samples analyzed, these studies embody a general approach to the ways managers think about design issues. Therefore, results may be considered more representative of intermediate levels of expertise. As Ford and Hegarty (1984) argued, training received by the participants would account for the correspondence between their cognitive representations and scientific organization theories.

Other studies reflect the "naïve" view of organizational design held by most people who have no training or experience in the field. Bhargava and Sinha (1992) found that both students and employees ascribed greater efficacy to heterarchical than to hierarchical organizational structures, regardless of the level of uncertainty in the organizational environment. Similarly, Rico et al. (2004) found that the members of different organizations perceived lateral structures as more effective than traditional structures in a range of areas (e.g., economic results, employees' well-being). However, Campion and Stevens (1988) offered a contrary view of naïve behavior in the design of work. Results of their laboratory study showed that nonexperts applied criteria proper to a mechanistic approach to job design, such as task similarity. These mixed findings can be explained in terms of the different measures utilized. Studies suggesting that nonexperts prefer lateral organizations which are close to organic systems asked participants only to predict the effectiveness of certain organizational structures and design criteria, while all the variables involved were established by the researchers. On the other hand, the task set by Campion and Stevens required participants to decide on the form of jobs with no further guidance. In these circumstances, nonexperts appeared to rely on job prototypes to resolve the problem successfully, and the mechanistic approach was simpler.

Overall, the above findings raise general expectations regarding the questions addressed in our study. Thus, it might be hypothesized that people with a certain expertise in organizational design would develop organizations that were consistent with the core thinking of scientific organization theories (e.g., organic organizations in unstable environments), while nonexperts would develop organizations similar to traditional mechanistic models.

Method

In this study, we have defined organizational design expertise based on the type and quantity of training received with content relevant to design, and the type and quantity of experience in actual design or redesign projects. These are two of the most frequently used criteria in the investigation of expertise (e.g., Ericsson and Smith 1991; Hoffman et al. 1995). Thus, we established three cut-off points along a hypothetical continuum of organizational design expertise.

First, naives had never taken part in any training program or formal project related to design. Second, novices had participated in an organizational design course as a part of an MBA program with a minimum of 30 h, but lacked actual hands-on experience. In this course, novices learned the essentials of organization theory and design, determinants and effects of organizational design, and new design trends. The sequence of training consisted of explanation and comparison of different approaches to organizational design, discussion of their advantages and disadvantages

under particular circumstances, and solution of micro-cases in small class groups. Finally, experts had extensive design training (overall more than 30 h), had taken part in several organizational design or redesign projects, and had held positions involving decision-making in this area. For experts, training consisted of courses and professional workshops in which they learned organization theories, approaches to organizational design, and specific methods of planning and dealing with organizational design and change processes (e.g., reengineering processes, job design). In addition, experience in organizational design included implementation of total quality programs, assessment of the effectiveness of organizational structures, and advising companies on the reorganization of their work structures under major changes such as mergers or acquisitions. These experiences provide experts with ample opportunities to practice and develop expertise in the domain.

Participants

For the purposes of data collection, we contacted a large business school in Spain. Letters of invitation to participate voluntarily, including an explanatory statement of the study and a consent-to-participate form, were sent out. Participants were first asked to complete a questionnaire about their training and experience with organizational design in order to establish their degree of expertise in this domain. They were assured of the confidentiality of their responses.

Three separate sample groups participated in this study. Sample 1 (naive) consisted of eight individuals (four men and four women) with an average age of 28 years and 4 years' work experience. All of them were graduates (major in psychology, business science and english, respectively), and they were employed in three different companies (government, education, retail distribution). For this sample, we identified participants in an introductory accounting course at random from the business school database. Sample 2 (novice) was also made up of eight individuals (four men and four women) with an average age of 29 years and 3 years' work experience. All of them were graduates (major in sociology, engineering and business science, respectively), and they were employed in various firms operating in the high technology and consulting industries. For this sample, we recruited final-year students from a part-time MBA program. Sample 3 (expert) consisted of eight men with an average age of 48 years and over 10 years' work experience. Six were MBA graduates, and two held PhDs in organizational behavior. Two were university professors, three business consultants, and three executives in two companies in the high technology and retail distribution industries. We identified experts from the business school personnel records.

All participants were invited to take part in a feedback session in which we presented the research findings and practical guidance in the area of organizational design.

Task and Materials

Based on our review of the literature (e.g., Daft 2006; Galbraith 1995; Robbins 1990), we developed a specific organizational design problem to elicit the participants' mental models. The problem was set out according to the following criteria: (a) open-ended problem that would be novel for all participants, (b) applicable at different levels of expertise, and (c) relevant content in the domain of organizational design. Two cognitive scientists and two specialists in organizational behavior judged the task independently, confirming that it was appropriate for the purposes of the study.

The problem was, "*Imagine you are a consultant in organizational development processes and that we are a group of investors seeking your collaboration in a project. We wish to create an organization in the textile industry. We have asked you to make a specific proposal for the creation of an organization to design and manufacture made-to-measure prêt-a-porter garments*". The problem also supplied information on the environment and certain tasks and activities of the organization in order to enhance the realism of the situation. Considering the environmental dimensions of complexity and uncertainty, we prepared the following description of a hypothetical complex, dynamic organizational environment, "*The prêt-a-porter manufacturing sector has undergone rapid, far-reaching change in recent years. Customers are ever more numerous and various. This has led new companies to open in your area, increasing competition. The customer profile has also changed and the market has expanded to embrace new age groups and socio-economic classes. The economic record of the sector has been variable with unpredictable cycles of growth*". Thirty-five examples of organizational tasks supplemented this information. Twenty of these were specific to the textile industry (e.g., pattern cutting, pressing clothes), while the remaining 15 were generic (e.g., customer advice, financial administration). To ensure that these tasks were representative, we drew examples from the *Dictionary of Occupational Titles* (Lynn 1991).

All of the information was presented on a 40 * 60 cm magnetic whiteboard where the participants could also sketch their solutions. Statements of the tasks were provided on individual magnetic cards allowing them to be easily rearranged on the board. Additional information and details about the materials can be obtained upon request.

Procedure

The participants carried out the task individually, in the same room and in the presence of the same researcher. They were instructed to think aloud (i.e., to verbalize what they were thinking as much as possible) while solving the problem by performing a warm-up exercise (see Ericsson and Simon 1993), so that their utterances could be recorded. When the researcher verified the proper use of the procedure, participants were asked to read the instructions and begin the task. Information remained available at all times. All of the sessions were audio–video recorded for subsequent analysis. Participants gave written consent to this video procedure.

The task lasted 30 min. This time limit was decided according to results from a previous pilot study which indicated that 30 min was sufficient to elicit relevant content of mental models without imposing high time pressure on participants to solve the problem. During the task, the researcher confined herself to reminding the participant to think aloud, monitoring recording and the time elapsed, and clarifying any doubts. Once the task was completed, participants analyzed the video recordings with the researcher to clarify any ambiguities or doubts in the information captured. Depending on the video contents, the researcher asked participants to explain their performance during the task by answering questions about what they were doing, how and why. This information was used later to assist with the analysis process. Finally, participants answered some questions about the degree of difficulty, interest and validity of the task to make their knowledge of organizational design explicit.

Data Analysis

The analysis of thinking-aloud protocols is one of the most effective methods of examining the mental models and problem-solving strategies applied by individuals in specific situations (DuBois and Shalin 1995; Hoffman et al. 1995). In this study, verbal protocols captured while the problem was being solved were used as the main source of data to understand the role of expertise in the cognitive dynamics and outputs of organizational design. This technique allowed in-depth analysis of the sensemaking process for each participant.

The processes described by Ericsson and Simon (1993) were used to manage the data for analysis. We fully transcribed the verbal protocols and segmented them into a series of complete thoughts. The segmentation unit employed was the linguistic sentence. To code the protocols, we created a coding scheme comprising nine categories (see Appendix). We defined these categories following cognitive science insights about relevant responses to examine problem-solving, such as planning and evaluating. We also considered observations of individuals' behavior (e.g., classifying information) made in the course of a pilot study. Since computational formulae do not appear to be a very effective means of representing cognition in complex, ill-defined problems (Militello 2001), we employed a conventional graphics program to communicate our main findings.

Results

We have divided the results into two groups based on the objectives of the study. First, we summarize our main findings regarding the cognitive dynamics driving the organizational design processes. Second, we describe the features of the organizational forms developed within each of the expertise groups.

Expert/Nonexpert Cognitive Processing Differences

Following the procedure described in the "Method" section, two independent raters analyzed the verbal protocols. Raters were blind to the study's objectives and familiar with the task and coding scheme. Interrater reliability was acceptable ($\kappa = .90$, .87; for segmentation and coding, respectively). We examined the results both qualitatively and quantitatively in order to answer the questions considered in the study.

Problem-Solving Approaches to Organizational Design

The coding categories were related with the two general problem-solving phases. Thus, "explore", "goals" and "planning" correspond to the representation phase and "structure", "justify", "evaluation" and "correct" to the solution phase, while "describe" and "difficulties" are related with both (see Appendix). This allowed us to regroup the categories in the representation and solution phases. Comparing results at the intra- and intergroup levels, we identified a series of regularities in the design approaches taken by the different expertise groups (see Fig. 1).

The upper part of Fig. 1 presents the naive organizational design process. During the representation phase, the naives expressed difficulty in understanding the demands of the problem, leading them to transform the instruction of designing an organization into a more familiar task (N4: "*So I'm supposed to say how the business would start up*"). The solution phase began early. The naives structured the organization through a series of iterative approximations, making extensive use of the information provided, selecting, classifying and even organizing the tasks by order of

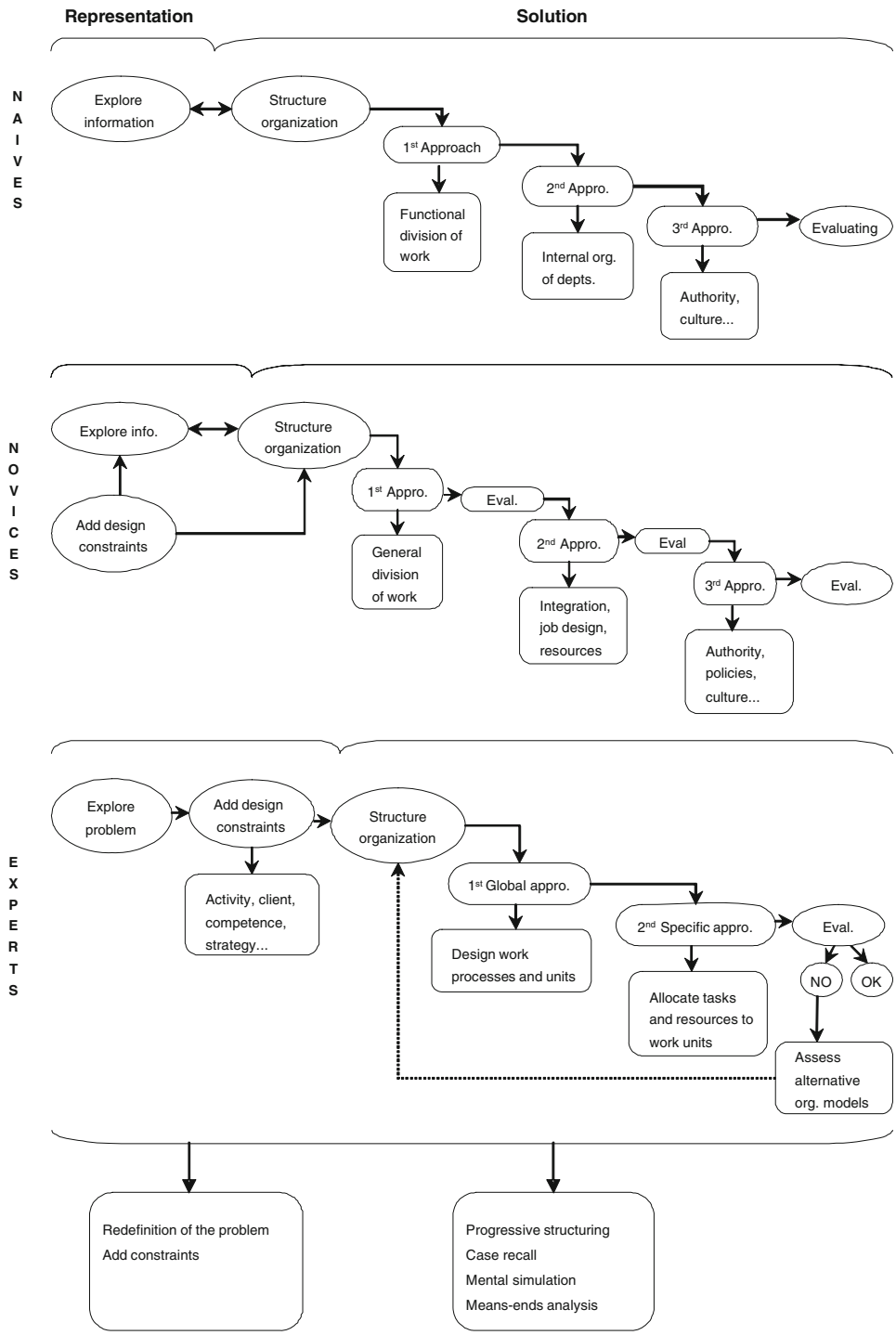

Fig. 1 Organizational design processes

performance (e.g., production). They employed two general strategies to decide on design: (a) recalling examples of known organizations (N5: "*I've based this on the organization where I work, because I like the way employees are treated*"); and (b) imagining the organization in operation (N2: "*I'm trying to imagine the place where the organization would be located, the facilities…*"). The naives concluded the design by checking the fit of their proposals with the demands of the problem, and only occasionally made minor changes (e.g., changing the order of two tasks in a sequence of activities).

The central part of Fig. 1 illustrates the novice design process. The novices approached the problem following two main routes. Some explored the information and then decided on their course of action, while others added design constraints before exploring the information. Like

the naives, the novices' solutions were based on a progressive structuring of the organization. For this purpose, they turned to cases of organizations that they knew either directly or indirectly (No6: "*I'm thinking of the case of IKEA, which I've followed in the press*"). Unlike the naives, however, the novices deliberately recalled specific domain knowledge (No4: "*I'm trying to remember the theory I studied in class. What was it called…*"). Another characteristic feature in this group was the tendency to stop the process periodically in order to evaluate the solution and plan the next action (No8: "*OK, next step… coordinate the areas*").

Finally, the lower part of Fig. 1 depicts the expert design process. The experts began by exploring the problem in depth and describing the design constraints (E2: "*Before choosing the model for the organization, it's necessary to look at a series of factors. What does the organization do, who for, who does it compete with?*"). The solution phase consisted of an initial global approach, in which the experts defined the main work processes based on their specialist knowledge (E4: "*Let's think first about the work process going on in the organization*"), distinguished the main areas of activity and identified the internal and external dependencies of the organization (E1: "*Let's not forget there's a legal, social and political framework that conditions the activity…*"); followed by a more specific approach, in which they considered the information provided in order to complete the organization. At this point, some experts anticipated long-term changes in the organization (E5: "*If we achieve a reasonable local market share and continue growing, we'd need to think about expanding into global markets*"). When the experts encountered flaws in their designs, they tended to evaluate alternative organization models.

As we have already noted, and in line with Hypothesis 1, the participants used several general strategies to solve the organizational design problem (see Fig. 1). The majority of these strategies were observed in at least half of the cases for each group, except redefining the problem and adding constraints. Thus, in the representation phase all of the naives sought to redefine the problem, compared to 25% of novices and none of the experts. Meanwhile, all of the experts and half of the novices added design constraints before choosing a particular organizational form, identifying analogous constraints (e.g., customers, competitors). In the solution phase, the different groups employed similar strategies to tackle the design. All of the participants applied progressive structuring in combination with case recall (87.5% for each group), mental simulation (87.5%, 62.5%; for naives and novices and experts, respectively), and means-ends analyses involving the examination of incongruities between the actual organization and the desired organization, as well as paths to close the gap (75%, 87.5%, 100%; for naives, novices and experts, respectively).

Distribution of Time and Coding Categories

The means, standard deviations and mean differences for key variables by expertise level are reported in Table 1.

Hypothesis 2 predicted that experts would spend more time than nonexperts representing the problem. To test this hypothesis, we carried out a nonparametric Kruskal-Wallis H test. The results indicated that there were significant differences in the time taken by each group over the representation and solution phases (see Table 1). We also conducted post hoc comparisons using the Mann–Whitney U test for two independent samples accompanied by the Bonferroni correction, which is recommended as a control for the error rate and consists of dividing a level of signification equal to .5 by the number of comparisons (Pardo and Ruiz 2002). As three comparisons were needed, the level of signification was .017. Results showed that all groups differed significantly from one another. The experts spent more time on the representation of the problem than the other groups, while the novices spent longer on this phase than the naives. By contrast, the experts took less time over the solution phase than the other groups, but

Table 1 Summary Statistics for Distribution of Time and Codification Categories by Expertise Level

Variable	Naives		Novices		Experts		χ^2
	M	*SD*	*M*	*SD*	*M*	*SD*	
Time[a]							
Representation	2.35_a	0.59	4.70_b	0.66	6.09_c	0.56	19.90*
Solution	25.75_a	1.33	24.45_a	0.81	23.09_b	0.85	14.55*
Total	28.10	1.44	29.15	0.71	29.17	0.57	3.94
Categories							
Explore	11.87	2.10	10.75	2.12	9.87	1.81	3.23
Goals	1.87	0.64	1.75	0.46	2.25	0.46	3.57
Planning	1.50	0.55	1.87	0.83	1.75	0.71	0.96
Structure	14.00	2.27	16.25	1.67	15.12	2.10	3.81
Describe	18.37	1.60	17.75	2.43	17.25	1.98	1.49
Justify	2.75_a	1.03	5.87_b	1.64	7.37_c	1.41	15.71*
Evaluate	2.37	0.52	3.00	1.07	2.75	0.71	1.98
Correct	2.25	0.71	2.62	0.52	2.00	0.76	3.17
Difficulties	3.37_a	1.19	1.62_b	0.74	0.50_c	0.53	17.04*
Specialist justifications	0.00_a	0.00	2.50_b	0.74	5.50_c	0.60	20.40*

Note. $n = 8$ for each group. Means that do not share a common subscript differ significantly from each other ($p < .017$). $df = 2$ for each variable

[a] Time was measured in minutes

* $P < .01$

there was no significant difference between naives and novices. This supported Hypothesis 2.

Hypothesis 3 predicted that experts would justify their design proposals more frequently than nonexperts. We tested this hypothesis using the strategy described above. Also, we analyzed differences in the remaining coding categories. Based on the results reported in Table 1, the groups differ only in the "justify" and "difficulties" categories. Post hoc comparisons verified that all the groups differed significantly from each other ($p < .017$). The experts justified their designs more and expressed less difficulty than the other groups. Following this pattern, the novices justified their designs more and expressed less difficulty than the naives. This supports Hypothesis 3.

We examined the content of the protocols to understand the nature of the differences in the "justify" and "difficulties" categories. Comparing the verbalizations for these categories, we observed that types of justifications and difficulties differed among expertise groups. We have treated responses that appeared in at least half of cases for a given group or allowed relevant differentiation across expertise levels.

Five classes of justifications were found depending on the type of knowledge in which they were grounded. These were (1) specialist justifications based on relevant, specific knowledge of design issues (E7: "*In an uncertain and competitive environment, you need a flexible structure with the capacity to learn and respond quickly to change*"); (2) realistic justifications derived from general knowledge about how organizations work (N3: "*The departments are the pillars of the structure. That's how all organizations work*"); (3) psychological justifications based on intuitions about human behavior (No2: "*People work better when they are motivated and you motivate them with incentives, like a good salary*"); (4) logical justifications based on ideal criteria of temporal sequencing, order, etc. (N2: "*Grouping similar tasks in the same department is a systematic way of organizing work*"); and (5) value-based justifications derived from personal values such as the meaning of work or relations with authority (N6: "*My organization has a hierarchy because I believe authority is necessary in an organization. Somebody has to make the rules, otherwise there'd be chaos*"). The naives gave realistic justifications (59.1%), as well as psychological, logical and value-based justifications in equal measure (13.6% for each type). The novices used both specialist (42.5%) and realistic (31.9%) justifications, followed by psychological (10.6%), logical (8.5%) and value-based (6.4%) justifications. Finally, the experts primarily offered specialist justifications (74.6%), followed by realistic (15.2%) and psychological justifications (10.2%).

Hypothesis 4 predicted that experts would build more relevant justifications to support their design proposals than nonexperts. To test this hypothesis, we analyzed between-groups differences in specialist justifications. Results indicated that groups differ in this type of justification (see Table 1). Post hoc comparisons showed that all groups differed significantly from one another ($p < .017$). The experts used more specialist justifications than the other groups, while the novices used more specialist justifications than the naives. These results indicate a tendency to apply specialist, domain-relevant knowledge to decide on the design of an organization to the detriment of nonspecialist, intuitive knowledge as the level of expertise rises. Hypothesis 4, thus, received support.

With respect to difficulties, the protocols revealed the existence of three general types: (1) declarative difficulties regarding the demands or the what of the problem (N4: "*What does create an organization mean? An organization chart, the steps to set up a business?*"); (2) technical difficulties concerning the sequence of action to design an organization, or how to go about the problem (N8: "*I've got the idea for my organization, but I don't know how to put it into practice*"); and (3) strategic difficulties regarding the appropriate model of organization to create and why (No3: "*A traditional or flat organization, project teams...which is better?*"). The naives experienced declarative (51.8%) and technical (40.7%) difficulties, and the novices notably more strategic (84.6%) than technical (15.4%) difficulties. The scant difficulties encountered by the experts were also of a strategic nature. Hence, low levels of expertise in organizational design appear to be associated with declarative and technical difficulties when solving a problem in the domain, and higher levels with strategic difficulties.

Expert/Nonexpert Organizational Forms

The protocols were also examined with a view to describing the organizations resulting from the design process. On an initial inspection, the data showed that participants applied similar design criteria at two levels of organizational complexity, regardless of their level of expertise. The basic, general aspects of an organization, such as division of labor, coordination of functional areas and structure of authority were decided at the organizational level. On the other hand, factors related with people and job design, such as task variety, learning, motivation, autonomy and participation were considered at a micro, job level. Given the similarity of these design criteria to the principles of organization theory, we employed the latter to outline the participants' proposals.

We first selected those criteria that appeared most frequently in the different expertise groups. Thus, we used complexity, formalization, centralization and coordination

at the organizational level, and task variety, autonomy and participation at the job level. We defined these criteria according to the relevant literature (Hackman and Oldham 1980; Robbins 1990). Two independent raters, who were blind to the study's purpose, analyzed the videos of the sessions to determine the extent to which the proposed organizations featured the design variables concerned. Raters assigned to each variable either a value using a scale ranging from 1 (*very low*) to 5 (*very high*) or a brief descriptive label (e.g., coordination via control or communication) (κ = .92).

Table 2 summarizes the means, standard deviations and mean differences for design variables by expertise level. The results of the Kruskal-Wallis H test showed significant differences between groups for all of the design variables, except the size of the organization (see Table 2). Post hoc tests showed that the naive group differed significantly from the other two groups ($p < .017$), which did not differ from each other. The naives designed more complex, formal and centralized organizations than the novices and experts, and they also based coordination on hierarchical control while the other groups opted for horizontal communication. Furthermore, the naives designed jobs with lower levels of task variety, autonomy and participation.

Table 2 Summary statistics for organizational design criteria by expertise level

Variable	Naives		Novices		Experts		χ^2
	M	*SD*	*M*	*SD*	*M*	*SD*	
Organization level							
Size[a]	1.75	0.46	1.50	0.53	1.63	0.52	1.02
Vertical differentiation	4.25[a]	0.71	2.50[b]	0.76	1.88[b]	0.83	15.61**
Horizontal differentiation	4.25[a]	0.71	2.50[b]	0.76	2.50[b]	0.83	14.66**
Formalization	3.50[a]	0.53	2.13[b]	0.64	1.88[b]	0.64	14.36**
Centralization	3.38[a]	0.74	2.38[b]	0.52	2.00[b]	0.53	11.37**
Coordination[b]	1.25[a]	0.46	1.63[b]	0.52	1.88[b]	0.35	6.24*
Job level							
Task variety	1.38[a]	0.52	3.38[b]	0.52	3.75[b]	0.71	17.02**
Autonomy	1.50[a]	0.53	3.25[b]	0.46	3.38[b]	0.52	17.41**
Participation	1.50[a]	0.53	3.38[b]	0.52	4.13[b]	0.64	18.28**

Note. $n = 8$ for each group. Means that do not share a common subscript differ significantly from each other ($p < .017$). $df = 2$ for each variable

[a] Size was coded as 1 = small/medium, and 2 = large

[b] Coordination was coded as 1 = hierarchical control, and 2 = communication

* $p < .05$; ** $p < .01$

Discussion

The purpose of this study was to examine the role of expertise in the sensemaking process underlying organizational design and the output organizations. We used a free choice problem to emulate two basic phases in any organizational design process in people with differing levels of expertise in the domain. These are the elicitation of mental models and their progressive translation into particular organizational forms. The relationships found between expertise, cognitive processing and organizational design identify relevant issues for research into the areas of both expertise and organizational design.

Our study contributes to the expertise literature by shedding light on expert and nonexpert problem-solving patterns in the organizational design domain. The differences found in problem-solving strategies, the time spent on the problem representation and the justifications of solutions are consistent with the main findings of cognitive research into expertise in various knowledge domains, especially those that are poorly defined (e.g., Ericsson and Simon 1991; Glaser 2000; Oura and Hatano 2001; Patel and Groen 1991; Peskin 1998; Taylor 2002). As we expected, the participants employed general strategies to resolve the organizational design problem. Although these strategies were common across the different levels of expertise in the solution phase of the problem, results reveal important differences in the representation phase. Whereas the experts and novices added design constraints, the naives sought to transform the problem into a familiar task. Choosing and defining constraints involves knowing the key variables that affect the form of an organization, and this fact may explain why only participants with a certain level of expertise apply this strategy. The redefinition of the problem allows naives to deal with the design in the absence of relevant knowledge, but it increases the risk of weak solutions (Voss and Post 1988). Furthermore, this pattern of results may account for the timing differences in the representation phase, since the experts and novices, who spent more time representing the problem, identify the design constraints before developing an organizational form. Our results thus support the argument that adding constraints is an effective mechanism for solving complex, ill-defined problems, such as organizational design, to the extent that this strategy limits the problem space, thereby producing workable mental models that reduce the number of possible solutions (Glaser and Chi 1988; Lawrence 1988; Simon 1973).

Another relevant finding from this study is that experts justified their design proposals more often and cogently than nonexperts. The importance of justification in organizational design can be related to the need to ground approaches because there are no clear-cut solutions (Peskin 1998; Zeitz

1994). Our results indicate that the arguments employed to support design proposals become more relevant and specific in line with the development of expertise. Thus, the experts' justifications basically contain specialist knowledge, while those of the naives are based on general beliefs and intuitions about the structure and functioning of organizations. This increased ability to argue in favor of a given design approach can help individuals to disseminate their envisioned improvements throughout their organizations, thereby achieving sufficient acceptance and legitimization to effectively implement change (Weick 1993).

Verbal protocols also revealed interesting differences in the types of difficulties encountered by the different expertise groups in solving the design problem. As we move from the naïve to novice level of expertise, declarative difficulties (concerning the *what* of the problem) disappear; technical differences (*how*) decrease notably; and strategic difficulties (*when* and *why*) appear for the first time. These results suggest a parallel with the phases of expertise development in Anderson's (1993) ACT model. It could be argued that the novices have acquired a degree of technical expertise in organizational design, indicated by their use of declarative and procedural knowledge, in contrast to the naives, who are reliant on preconceptions and intuitions. On the other hand, the experts would have attained a degree of strategic expertise, reflected not only in their extensive application of specialist knowledge but also in the flexibility with which it is employed to create solutions tailored to the design problem. Longitudinal descriptive studies examining the evolution of expertise in organizational design and the conditions that facilitate the creation of the different types of knowledge would help test these insights.

Our study also contributes to the organizational behavior literature by providing evidence for the role of expertise in the organizational forms arising out of design process. Findings reveal that people with differing levels of expertise apply similar criteria in unconstrained design situations. Moreover, such criteria are analogous to those employed by organizational researchers and practitioners. Thus, designs are articulated around a central constellation of complexity, formalization, centralization and coordination at the organizational level, and task variety, autonomy and participation at the job level. This suggests the utility of classic organizational design criteria and other theoretical approaches, such as the job characteristics model (Hackman and Oldham 1980), as guidelines or frames of reference for organizational design (Daft 2006; Harrison and Shirom 1998; Weick 1993).

Despite the similarities in design criteria, naives differ from novices and experts in the values they assign to them and the ways in which they are combined. Organizational forms created by the former are similar to traditional mechanistic organizations, while those created by the latter take a more organic approach. For a dynamic and uncertain environment, such as that described in the study problem, contingent theories support the superiority of organic rather than mechanistic organizational structures, because they are more flexible and responsive to change (e.g., Lawrence and Lorsch 1967; Robbins 1990). Therefore, extending the prior work of Ford and Hegarty (1984) and Campion and Stevens (1988), we may conclude that the organic organizations proposed by novices and experts are consistent with the recommendations contained in the literature, while the mechanistic organizations of naives contradict such recommendations.

Our consistent pattern of intragroup and intergroup differences reveals the key role of expertise in the creation of particular organizational forms. Differences in both training and experience among participants help us to understand such differences. In our study, the experts and novices shared a background of training in the subject of organizational design (low in the case of novices). The exposure of both groups to this formal knowledge context may account for the similarities between their design approaches and the parallels between these and theoretical approaches. In contrast to the novices, however, the experts had work experience in design projects and in positions of responsibility for decision-making in design matters. The features of the samples do not allow us to distinguish between the potential effects of training and experience in the domain, which would require an additional group with experience but without training. Thus, expert-novice differences in organizational design (i.e., emphasis on problem representation, types of justifications, and use of strategic knowledge) could be due either to the more extensive training of experts or to their experience. We could hypothesize that while experience is a critical factor for the creation of strategic knowledge in the domain of organizational design, training may facilitate learning in natural settings by providing individuals with relevant conceptual frameworks for the interpretation of such experience (Schön 1994).

On the other hand, the naives had neither training nor experience of organizational design, and were therefore obliged to rely on intuitive theories to solve the problem. Intuitive theories are acquired through observation and day-to-day experience and are articulated around the superficial characteristics of the domain (Markman and Gentner 2001). The historical predominance of the mechanistic model could thus explain the tendency of the naives to create organizations of this kind. As Campion and Stevens (1988) point out, naïve design approaches reflect prototype solutions in the organizational sphere, which are more accessible, straightforward and apparently rational. Further, by emulating well-known organizations, the naives may gain a sense of the appropriateness of their proposals. Also, naives' traditional organizations could reflect their experience in particular work settings. Naives and novices

in our study were similar in mean ages and years in the workforce. However, they differed not only in their training in organizational design, but also in the types of organization where they worked. Naives worked in organizations that could be described as traditional bureaucracies or hierarchies (i.e., education, government and to a lesser extent, retail distribution), while novices worked in industries that tend to be organized in less traditional hierarchies (i.e., high-technology and professional consulting). From our results, we cannot differentiate the potential impacts of training and work experience on organizational forms. This would require comparing equivalent groups of novices working in mechanistic organizations and naives working in organic organizations, respectively. Further studies are needed to explore systematically the potential independent and joint effects of domain-relevant expertise and general work experience on shaping individuals' thinking about organizational design.

Overall, given that naives' intuitive design theories are a product of socialization and experience in the context of organizations, they will reflect the basic properties of the predominant mechanistic structures. Findings suggest that training and experience can modify such intuitive theories by providing people with relevant knowledge to develop solutions. It is an open question whether the expansion of new forms of postindustrial organizations (e.g., team-based or virtual organizations) will result in comparable changes in intuitive theories over time.

With respect to methodology, it may be of interest to consider our approach to the elicitation of the mental models driving sensemaking in the context of organizational design. Analyzing the role of knowledge representations in the solving of complex problems poses a considerable methodological challenge that partly explains the slow development of empirical work in the field. As far as we know, this is the first study that employs protocol analysis to explore the effective use of knowledge to deal with specific organizational design problems. Our results suggest the utility of verbal protocols to capture the dynamic mutual relationships between cognition and action which occur in the course of the design process (Weick 1993). This approach may also provide a powerful organizational learning tool, making tacit knowledge explicit and stimulating meta-reflection, which can be an effective means of building strategic knowledge (Nonaka et al. 2006). However, it is necessary to improve this approach and develop new techniques to assess dynamic knowledge, which would stimulate further empirical research. Observation measures, communication protocol analysis and interruptive analysis are promising procedures in this respect (Hoffman et al. 1995; Militello 2001).

Our findings also contain a number of practical implications. As expert/nonexpert differences reveal, organizational design competences can be developed through appropriate learning situations. This is good news for companies given the increasing involvement of employees in design activity (e.g., self-managing teams, empowerment). The transition from naïve to novice or expert designer implies developing specific knowledge of the what, how and why of organizational design. Our results inform educators in business schools, practitioners and HR managers on how to design training programs to facilitate development of the different types of knowledge involved. Useful guidelines include a constraints-based approach to solve problems (vs. a traditional instructions-based approach), reflective practice guided by relevant conceptual models, linking learning to personal experience in the organizational sphere, and experimenting with new designs under simulated conditions (e.g., Mohrman et al. 1995; Morgan 1994; Schön 1994; Vicente 2000). It would be also valuable for managers to consider the potential benefits of design training in corporate change or development processes. Since the success of these interventions depends to a great extent on transforming employees' mental models in line with the new systems, structures and practices, training could be a fruitful support strategy when managing complex organizational change (Mohrman et al. 1995; Weick 1993). Beyond training, support systems in the area of organizational design could be developed. These systems should be adapted to the users' knowledge representations and task requirements, thus reducing difficulties and ensuring adequate support. To do so, findings offer recommendations such as reinforcement of case-based reasoning and mental simulation by providing real cases and enhanced situational representations; guidance in problem representation and means-end analysis to properly frame the design problem; facilitating the creation of relevant mental models by providing specialized knowledge and information on the key factors involved; and increasing flexible, strategic thinking by presenting alternative organizational forms and likely long-term changes. Given increasing entrepreneurship, these systems may well be especially relevant to enhancing managerial cognition in the creation of new ventures (Forbes 1999).

Further, managers should pay greater attention to the initial phases of organizational design or redesign process. Our results suggest that generating a precise mental model of the key implicit constraints and desired changes in the early representation phases of the process can facilitate decision-making in the later implementation phases. This increased focus on problem representation offers real decision-makers a great opportunity for developing a shared vision. Since design problems allow multiple approaches, discrepancies in the mental models held by stakeholders (employees, customers, managers, etc.) are likely to emerge. By making their mental models explicit

and negotiating planned changes, they can attain the necessary consensus for successful implementation.

Despite its theoretical and practical contributions, this study suffers from a number of limitations. First, we have analyzed the cognition underlying design processes at the individual level in a simplified laboratory situation. It is therefore necessary to test the external validity of the research findings in applied settings. Since corporate decisions usually involve a range of strategic constituents of the organization, future research should examine the role of expertise in situations where diverse design approaches come into play. It would be interesting to examine how such approaches are coordinated and the effects of differences in status, power and expertise on this dynamic. The reactions of the organization's members are also worth considering. The designs created by expert designers may initially appear more elegant, yet they will fail if they lack acceptance and commitment. Descriptive field studies and experimental simulations combining quantitative and qualitative measures would be valuable research strategies to explore these issues. Second, we have defined design expertise in terms of the type and amount of training and experience in the domain, identifying three discrete categories along a hypothetical expertise continuum. It is simple to define the naïve category for obvious reasons, but it is by no means so easy precisely to draw the distinction between intermediate and advanced levels of expertise, given the lack of clear criteria. A more refined measure of expertise might include criteria such as peer judgments or knowledge tests. This would allow us to explore other levels and different kinds of knowledge (e.g., academic versus technical), providing a more complete map of design expertise. Third, the small size of our sample represents both a strength and a weakness. Consistent with expert-novice studies, examining small samples allowed us to conduct the process-oriented analysis of cognition underlying organizational design in people with differing domain-relevant expertise, which is the study's focus. This approach provides an in-depth understanding of the phenomenon, though it is laborious and time-consuming. Thus, our sampling aims to identify representative samples of the target population in substantial and practical (rather than statistical) terms. However, the risk inherent in small samples is that they may yield results that are limited to the sample used. Thus, further research is required to fully test the generalizability of our results. Finally, performance measures should be considered in order to establish the value added by expertise. The degree of rationalization of design proposals or their similarity with scientific theories could be useful indicators. Our study, however, leaves open the question of whether developing the design expertise of an organization's members would improve organizational design, and whether this would in turn increase organizational performance.

To sum up, this study represents a further step in our understanding of the sensemaking process involved in organizational design. Our results illustrate how expertise provides people with valuable resources for the improvisation of designs. We hope to stimulate further research taking a cognitive approach to the exploration of the factors determining organizational design. Researchers are now faced with the challenge of developing learning systems capable of transforming design knowledge into an effective competitive advantage for companies.

Appendix

Coding scheme

Category	Definition
Explore	Read or reproduce the information presented (instructions, magnetic cards)
Goals	Describe the future states comprising the intermediate (sub-goals) and final (overall goal) objectives pursued through an action or set of actions
Planning	Anticipate the general lines of action that will be followed to solve the problem
Structure	Manipulate the information provided to generate a given structure. This includes selecting the elements required to solve the problem, differentiating between tasks, people and things, grouping the elements into categories, and ordering the elements based on relevant criteria
Describe	Describe the structural and functional properties of the proposed organization or the process followed to reach it
Justify	Verbalize the reasons behind the decisions and actions taken. Typical construction: "(I am doing / saying) A because B, C, D", where A is the verbal or nonverbal response and B, C and D are the reasons behind it
Evaluate	Check the appropriateness of the solution and the process followed to achieve it
Correct	Change any aspect of the solution
Difficulties	Verbalizations indicating difficulties in understanding or performing the task

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